

## Our work in defense and nuclear technologies helps to ensure national security and reduce the nuclear danger

### Mission

The Defense and Nuclear Technologies (DNT) Directorate is responsible for ensuring the safety, reliability, and security of the U.S. nuclear stockpile without nuclear testing, for developing advanced manufacturing and materials technologies to maintain the enduring stockpile, and for ensuring the safe dismantlement of retired weapons. Multidisciplinary teams apply this unique expertise to the development of technologies that reduce U.S. vulnerability to terrorist nuclear threats and that enhance the nation's conventional defense.

### Weapons science

The knowledge unique to nuclear weapons physics exists only at the two weapons design laboratories. Weapons science includes:

- **Nuclear weapon physics:** Theory, experimentation, and computations of physical properties and phenomena relevant to the safety, security, performance, and reliability of nuclear weapons.
- **Computer simulation:** Computational modeling of nuclear devices using state-of-the-art computers, physical and mathematical models, and databases.
- **Hydrodynamic experiments:** High-speed, high-resolution experiments to study implosions of primaries and assure their safety and reliability; hydrodynamic test facilities are being upgraded to compensate for the absence of nuclear testing.
- **High-power laser experiments:** Experiments with Nova to measure high-temperature and high-density phenomena related to thermonuclear weapons; the planned National Ignition Facility will bring us closer than any existing laboratory facility to the conditions that occur in a nuclear explosion.
- **Materials technology:** Development of new materials and environmentally sound methods for fabrication of replacement weapon components and disposition of retired weapon materials.
- **Stockpile maintenance:** Monitoring and testing of stockpile weapon components to ensure safety, security, and reliability; transformation of physics ideas into workable engineering solutions to meet stockpile needs.
- **Arms control and nonproliferation:** Assessments of intelligence data; evaluations of the proliferation potential of suspect nations; analysis of force structures; studies of arms-control and nuclear-weapon-related policies.

### Benefits to the nation

Nuclear deterrence remains a cornerstone of U.S. national-security policy. However, the cessation of nuclear testing and the termination of new weapon development have fundamentally altered the way the weapons laboratories ensure stockpile safety and reliability. Livermore has been a leader in the development of the Stockpile Stewardship and Management Program, a science-based approach for ensuring stockpile safety, security, and reliability that relies on enhanced experimental, computational, and weapons maintenance capabilities. A wealth of technological spinoffs from our nuclear weapons program, including computer codes like DYNA3D and global climate models, miniaturized electronics and instrumentation, lasers, and precision fabrication technologies, also benefit the nation.

## Recent Accomplishments

- Major progress in implementing science-based stewardship of the enduring U.S. stockpile.
- Resolution of serious weapons dismantlement problems through the development of corrective procedures.
- Development of new capabilities for detecting terrorist weapons and rendering them safe.
- Design and demonstration of a new gamma-ray camera for hydrodynamic testing. This camera produces images of much greater detail (more than double the resolution) than was possible with previous instruments and can obtain images at much later stages in the implosion process.
- Development of the concept for reusing plutonium pits from retired weapons and development of a precision die-casting method for producing new plutonium components with considerable waste reduction.
- Development of a self-contained apparatus for transforming plutonium pits into a form suitable for disposal as well as other methods for safely disposing of weapon materials.

## New initiatives

Livermore is working on several new initiatives that formalize existing efforts:

- **Dual Revalidation.** Two independent teams, one from our laboratory and Sandia-Livermore and the other from Los Alamos and Sandia-Albuquerque, will analyze the safety and performance of each stockpile weapon system with our most modern computational and experimental tools. Livermore played a key role in demonstrating the need for this fundamental approach to independent technical evaluation.
- **Accelerated Strategic Computing initiative.** Dramatically improved computational capabilities will be developed to provide the enhanced technical and quantitative foundation for the judgment-based stockpile decisions that will be required in the absence of nuclear testing.
- **Advanced Design and Production Technology initiative.** Advanced manufacturing technologies and processes will be developed to enable affordable production of high-quality, variable-lot components for stockpile maintenance.
- **Enhanced Surveillance initiative.** New predictive capabilities will be developed for early detection of age-related changes that affect weapon safety or reliability.
- **National Ignition Facility.** Major progress is being made in determining the facility and diagnostics requirements for experiments to study weapons physics issues with the National Ignition Facility.
- **Flash X-Ray facility upgrade.** This existing hydrodynamic test facility is being upgraded to provide two x-ray pulses, and hence two images, during a primary implosion. This technology, combined with a dual-x-ray-beam capability being built at Los Alamos, will be the basis for three-dimensional CAT-scan-like movies of the interior of an imploding primary.

## Contact

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